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Strategies For Promoting Problem-Solving Skills Among Metalwork Students As Perceived By Lecturers Of Colleges Of Education In Nigeria

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Abstract

This study examined the strategies perceived by lecturers of colleges of education in Nigeria for promoting problem-solving skills among metalwork students. The research sample consisted of 80 purposively selected respondents from various Colleges of Education in North-Central, Nigeria. Data was collected through a self-designed questionnaire and analyzed using descriptive statistics and inferential statistics. The questionnaire was validated by metalwork professionals and has a Cronbach reliability index of .91. The findings of the study revealed that flexibility and openness to new approaches; integrating critical thinking activities into the metalwork curriculum; providing students with opportunities to analyze alternatives; explore different sources of information and make informed decisions; sharing physical examples of metalwork projects and development of resilient and solution-oriented mindsets were identified as by lecturers/instructors as effective in promoting problem-solving skills among metalwork students. These findings informed curriculum development and instructional practices to enhance problem-solving abilities in metalwork education. It was recommended among others thus that the school authority and lecturers of metalwork should nurture students' flexibility and openness to new approaches in metal fabrication that encourage students' critical thinking and explore alternative solutions.

Keywords: *Strategies, promoting, problem-solving skills, metalwork students, perceived, lecturers of colleges of education.*

Introduction

Problem-solving skills refer to the ability to identify, analyze and resolve problems effectively and efficiently[1]. It involves a combination of cognitive abilities, critical thinking, creativity and decision-making (Rahman, 2019). Problem-solving skills are important for metalwork students as it may be crucial for their academic success. Students who can analyze problems, think critically and develop effective solutions are more likely to excel in their study. Whether it is solving math equations, understanding complex scientific concepts or writing persuasive essays, problem-solving skills are essential for achieving academic goals (Gurat, 2018). Because of the fact that problem-solving skills are highly transferable and applicable to real-life situations, regardless of the field or profession students pursue in the future, they will inevitably encounter some challenges that could possibly beyond their capacity to handle (Gurat & Medula, 2016). Developing problem-solving skills will equip students with the ability

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to navigate and overcome these challenges effectively, be it personal life, professional career or community involvement.

Problem-solving skills are closely linked to innovation and creativity. When students learn to approach problems from different angles, think outside the box and generate creative solutions, they become more innovative individuals (Cooks-Campbell, 2022). These skills are essential for driving progress, developing new ideas and making positive contributions to society. Developing problem-solving skills fosters personal growth and boosts self-confidence. As students overcome challenges and find solutions, they gain a sense of accomplishment and belief in their abilities (Wilson, 2023). This confidence may extend beyond problem-solving and positively impacts their overall academic performance and personal development. By cultivating problem-solving skills, students are better prepared to navigate the complexities of life, pursue their goals, and make meaningful contributions to society.

Poor problem-solving skills among metalwork students can have several consequences, both immediate and long-term. Metalwork projects often require precise measurements, calculations and planning. Poor problem-solving skills can lead students to make mistakes in these areas, resulting in inefficient use of materials, wasted time and rework (Lodge, et al., 2018). This can lead to delays in completing projects and negatively impact productivity. Metalwork involves working with potentially dangerous tools and equipment. Poor problem-solving skills can lead to incorrect or inadequate safety procedures, increasing the risk of accidents and injuries in the workshop (Abdalla, et al., 2017). Students may struggle to identify and mitigate potential hazards, compromising their safety and the safety of others.

Problem-solving skills are highly relevant to metalwork students. Metalwork involves designing and fabricating various metal structures, objects and components. Metalwork students often encounter design challenges that require problem-solving skills to determine the most effective and efficient solutions. They need to analyze specifications, consider material properties and devise strategies to overcome obstacles in the fabrication process (Benedetti, et al., 2021). Also, metalwork students must select appropriate materials based on the desired functionality, strength and aesthetics of the final product. Problem-solving skills help them evaluate different materials, consider their properties and make informed decisions. Additionally, students need to optimize material usage to minimize waste and reduce costs, which requires problem-solving abilities (Fujimori, et al., 2020).

This study is backed by the constructivism by Vygotsky (1978) and cognitive load by Sweller (1988) theories. Constructivism is a learning theory that suggests learners actively construct knowledge and understanding through their experiences (McLeod, 2023). In the context of metalwork, constructivism emphasizes hands-on learning and problem-solving activities. By engaging in practical projects and exploring real-world applications, metalwork students can develop problem-solving skills by actively constructing their understanding of metalworking processes and techniques. On the other hand, cognitive load theory focuses on how the cognitive load of learning tasks affects learning outcomes. In metalwork, complex problem-solving tasks can overwhelm students if they exceed their cognitive load capacity (Skulmowski & Rey, 2017). To foster problem-solving skills, teachers can break down complex tasks into manageable components, provide scaffolding and guidance and gradually increase the difficulty level as students' skills improve (Main, 2023).

Promoting problem-solving skills in metalwork students can greatly enhance students' ability to tackle challenges and develop critical thinking abilities. Some strategies to foster

problem-solving skills in metalwork students include providing open-ended projects, encourage critical thinking, foster collaboration, team research skills, scaffolding problem-solving process, encourage reflection, providing real-world examples and emphasizing adaptability and resilience (Rudolph & Jorgensen, 2020). Open-ended projects involve assigning metalwork projects that allow students to explore different design possibilities and solutions (Benedetti, et al., 2021). It encourages students to think creatively, make decisions and find innovative ways to solve problems encountered during the fabrication process.

In order to encourage critical thinking, an instructor can pose thought-provoking questions that require students to analyze and evaluate different aspects of a metalwork project (Hooker, 2017). He/she can encourage them to consider factors such as material selection, structural integrity, functionality and aesthetics; and justify their design choices and consider alternative approaches. Lecturers can foster collaboration among metalwork students by assigning group projects that require them to work together to solve problems. Collaborative work encourages students to share ideas, consider different perspectives and brainstorm solutions collectively (Rudolph & Jorgensen, 2020). It also helps develop communication and teamwork skills.

1.1 Problem Statement

Problem-solving skills are crucial for identifying and resolving issues that arise during the manufacturing process. Without strong problem-solving skills, metalwork students entering the manufacturing industry may struggle to troubleshoot problems effectively, leading to reduced productivity and efficiency in manufacturing operations. Metalwork students with poor problem-solving abilities may struggle to identify and address quality issues in manufacturing processes, resulting in subpar products that do not meet industry standards. This can negatively impact the reputation of Nigerian manufacturing and hinder its competitiveness in the global market.

Without the ability to analyze problems, generate creative solutions and implement improvements, metalwork students may struggle in contributing to innovation in the manufacturing sector. This can hinder the development of new products, processes and technologies that could drive growth and competitiveness. Also, as technological advancements and automation continue to reshape manufacturing processes, there is an increasing demand for workers with problem-solving abilities to operate and maintain advanced machinery and systems. The skills gap resulting from poor problem-solving skills can hinder the industry's ability to adopt and leverage new technologies effectively.

In addition, empirical studies are rear to establish the relevant strategies that could be adopted in equipping students with appropriate problem-solving skills that can enable them excel in their studies and be relevant in the world of work. Some of the available studies (such as Alwehaibi, 2012; Nold, 2017; Anderson et al., 2018; Bobrowicz & Thibaut, 2023) were not encompassing on strategies for promoting problem-solving skills in students. Few studies thus exist on this topical issue; hence, need to investigate how to improve problem-solving skills among metalwork students in Nigeria through strategies that emphasize practical problem-solving experiences, critical thinking exercises and project-based learning.

1.2 Objective of the Study

The main objective of this study is to determine the strategies for promoting problem-solving skills among metalwork students as perceived by instructors/lecturers of colleges of education in Nigeria.

1.3 Methodology

The research design adopted for this study was the descriptive survey. Descriptive survey method involves investigating a phenomenon in its natural setting and describing the picture of the events, that is, observation and careful study of existing attributes of a particular issue. Ayena (2007) stated that descriptive survey method enables the researcher to employ questionnaire or interview to seek the opinion of representative sample of the population upon which conclusion, inferences and generalization are made of a contemporary issue. Since this study aimed at investigating the perception of lecturers/instructors on strategies for promoting problem-solving skills among metalwork students, descriptive survey was considered appropriate for the conduct of the study.

The population for this study is 80 lecturers (50) and instructors (30) of metalwork in the five Colleges of Education in Niger State (2 colleges) and Kwara State (3 colleges), Nigeria. All the lecturers and instructors were purposively selected for this study. According to Morris (2023), for population size of less than 300, the researcher needs the entire population in order to achieve data accuracy. The respondents were sampled deliberately from their various departments. Purposive sampling is a non-probability sampling technique where subjects are selected because of their peculiarity and their significance to the problem under study.

The self-developed questionnaire entitled "Strategies for Promoting Problem-Solving Skills Questionnaire (SPPSSQ)" was used to collect data for the study. The questionnaire consisted of two sections; A and B. Section A, focused on the demographic data of the respondents, while section B consisted of 20 items on the strategies for promoting problem-solving skills. The Five Point scoring format was used as follows: Strongly Agree (SA) = 5 points; Agree (A) = 4 points; Neutral = 3 points; Disagree (D) = 2 points and Strongly Disagree (SD) = 1 point.

The instrument was scrutinized by experts in metalwork for content and context validity. The corrections and modifications on the items were incorporated into the final draft of the questionnaire, which affirmed it suitable for carrying out the study. The instrument went through a split-half method of reliability testing and a Cronbach Alfa reliability index of 0.91 was obtained, which is within the highly acceptable reliability region. Section A which consisted of three items on demographic data was scored using frequency and percentage. Sections B which contained items on strategies for promoting problem-solving skills was scored using the following modality: the score on the instrument ranges from 5 to 1 (5, 4, 3, 2, 1). So, the average score any respondents can obtain is 5+4+3+2+1= 15/5 = 3.0. This follows that mean scores from 3.0 and above indicated the topmost strategies; while mean score below 3.0 was regarded as insignificant strategies for promoting problem-solving skills. The research question was answered using mean ranking and the orderliness was determined by the values of Coefficient of Variations (Mean + Standard Deviation / 2).

2.0 Results

Research Question: What are the strategies for promoting problem-solving skills among metalwork students in Nigeria?

Table 1: Ranking of Coefficient Variation of Responses to Strategies for Promoting Problem-Solving Skills among Metalwork Students

S/N	As a lecturer/instructor, I believe the following strategies will enhance problem-solving skills among metalwork students:	Mean	SD	CV	Rank
1	Assigning metalwork projects for students to explore different design possibilities and solutions	3.05	1.330	2.19	7th
2	Encourage students to think creatively	3.30	.906	2.10	10th
3	Work with students to discover innovative ways to solve problems encountered during the fabrication process	2.91	1.295	2.10	10th
4	Pose thought-provoking questions that require students to analyze and evaluate different aspects of a metalwork project	3.28	.914	2.09	12th
5	Encourage them to consider factors such as material selection, structural integrity, functionality and aesthetics	2.92	1.300	2.11	9th
6	Make students justify their design choices and consider alternative approaches	3.21	.951	2.08	13th
7	Foster collaboration among metalwork students by assigning group projects that require them to work together to solve problems	2.94	1.306	2.13	8th
8	Guide students on how to conduct research related to metalwork techniques, materials and design principles	3.04	.295	1.67	19th
9	Encourage students to explore different sources such as books, online articles and videos to gather information, analyze alternatives and make informed decisions	3.12	1.496	2.31	3rd
10	Introduce students to the use of scaffold problem-solving process, which involves the breaking down of complex metalwork projects into smaller steps or stages	3.03	.317	1.67	19th
11	Incorporate regular reflection exercises in teaching where students can evaluate their problem-solving approaches	3.11	1.475	2.29	6th
12	Incorporate regular reflection exercises where students can identify challenges they encountered and reflect on the effectiveness of their solutions	3.11	.390	1.75	16th
13	Share physical examples of metalwork projects or design challenges that require problem-solving skills	3.12	1.496	2.31	3rd
14	Encourage students to embrace setbacks and unexpected challenges as opportunities for learning and growth	3.13	.432	1.78	14th
15	Help them develop problem-solving mindsets that are resilient and solution-oriented	3.16	1.453	2.31	3rd
16	Create a supportive and encouraging learning environment where students feel comfortable	3.05	.386	1.72	18th
17	Integrating critical thinking activities into the metalwork curriculum	3.07	1.439	2.25	2nd

18	Equip students with effective communication skills to enhance collaboration, information gathering and presenting solutions	3.11	.390	1.75	16th
19	Encourage students to be flexible and open to new approaches in metal fabrication	3.43	1.261	2.35	1st
20	Help students with skills to be able to identify patterns, relationships and connections between various elements of a problem	3.13	.432	1.78	14th

* CV = Coefficient of Variation; SD = Standard Deviation

Table 1 describes the ranking for coefficient of variation of Lecturers'/instructors' perception on strategies for promoting problem-solving skills of metalwork students in Colleges of Education in Nigeria. The table shows that 13 of the 20 items are above the average CV value of 2.0 (as benchmark for determining the main strategies). However, items 19 (with CV of 2.35), 17 (with CV of 2.25), 9 (with CV of 2.31), 13 (with CV of 2.31) and 15 (with CV of 2.31) were the five topmost ranked items (between 1st to 3th) respectively. Therefore, the strategies identified by lecturers/instructors for promoting problem-solving strategies among metalwork students include encouraging students to be flexible and open to new approaches in metal fabrication; integrating critical thinking activities into the metalwork curriculum; encouraging them to explore different sources such as books, online articles and videos to gather information, analyze alternatives and make informed decisions; sharing physical examples of metalwork projects or design challenges that require problem-solving skills; and helping them develop problem-solving mindsets that are resilient and solution-oriented.

3.0 Discussion

Encouragement of Flexibility and Openness to New Approaches in Metal Fabrication

This research finding revealed that one of the effective strategies for promoting problem-solving skills among metalwork students is through the encouragement of flexibility and openness to new approaches in metal fabrication. The finding corroborates the studies of Anderson et al. (2018); Bobrowicz and Thibaut (2023), which revealed that flexibility and openness to new approaches help metalwork students develop strong problem-solving skills. This finding highlights the importance of fostering a mindset that allows students to think critically and creatively in order to overcome challenges encountered in metalwork projects. The research study emphasizes the significance of encouraging students to explore alternative techniques, materials and designs when faced with problems during the fabrication process. By doing so, students will be able to develop a broader range of problem-solving skills and enhance their ability to think outside the box. The finding of the research study indicates that by promoting flexibility and openness to new approaches, metalwork students are more likely to engage in experimentation and take calculated risks; which does not only result in more innovative and unique metalwork projects but also enhanced their problem-solving abilities (Taylor, 2023). Students who were encouraged to be flexible in their thinking were better equipped to adapt to unexpected challenges and find creative solutions.

3.1 Integrating Critical Thinking Activities into the Metalwork Curriculum

The finding of this study also demonstrated that integrating critical thinking activities into the metalwork curriculum is an effective strategy for promoting problem-solving skills among students. This finding supports the studies by Alwehaibi (2012) and Nold (2017), whose findings emphasized critical thinking as correlates of problem-solving skills in students. This finding emphasizes the importance of incorporating activities that require students to analyze,

evaluate and apply their knowledge and skills in order to solve complex problems encountered in metalwork projects. This means that these lecturers actively incorporated critical thinking activities, such as case studies, problem-based learning scenarios and open-ended projects, into their curriculum. By this, they aimed to stimulate students' higher-order thinking skills and encourage them to approach metalwork challenges from a problem-solving perspective. The findings of the research study indicated that by integrating critical thinking activities, metalwork students will be able to develop a deeper understanding of the subject matter and enhance their problem-solving abilities (Onwusa & Nwaosa, 2020). Through analyzing real-world case studies or engaging in open-ended projects, students will be required to think critically, consider multiple perspectives and evaluate various solutions. This not only expanded their knowledge and skills in metalwork but also fostered their ability to approach problems creatively and find innovative solutions. Furthermore, the research highlighted the importance of providing students with opportunities for reflection and self-assessment. Lecturers who implemented this strategy encouraged students to reflect on their problem-solving processes and evaluate their own performance. This self-reflection helped students identify areas for improvement and develop a growth mindset, which is essential for further enhancing their problem-solving skills (Gurat & Medula, 2016).

3.2 Encouraging Students to Explore Different Sources such as Books, Online Articles and Videos

Another finding of this study revealed that encouraging students to explore different sources such as books, online articles and videos to gather information, analyze alternatives and make informed decisions is a significant strategy to promote their problem-solving skills. This finding is in line with the study by Uyen et al. (2021), which investigated the effectiveness of various teaching strategies to promote problem-solving skills in 8th grade students. The survey revealed that encouraging students to explore different sources of information such as books, online articles and videos was perceived as a successful strategy to promote problem-solving skills in metalwork students. The lecturers reported that this strategy was beneficial in giving students a broader outlook on problem-solving, as it allowed them to develop a deeper understanding of different solutions and approaches. Additionally, the lecturers noted that this strategy was effective in teaching students to analyze alternatives and make informed decisions. Similar finding was also reported by Bhakti et al. (2020). The result of this study suggests that encouraging students to explore different sources of information is an effective strategy to promote problem-solving skills in metalwork students. This suggests that metalwork Departments should consider incorporating this strategy into their teaching methods to help students develop their problem-solving skills.

3.3 Sharing Physical Examples of Metalwork Projects or Design Challenges

This research also showed that sharing physical examples of metalwork projects or design challenges that require problem-solving skills can help promote problem-solving skills among metalwork students. This result supports the studies by conducted by Lkama and Dabo (2019); Onwusa and Nwaosa (2020), which investigated whether sharing physical examples of metalwork projects or design challenges that require problem-solving skills is a successful strategy to promote problem-solving skills in metalwork students. The researchers found that teachers' modeling of physical examples of metalwork projects or design challenges was a successful strategy for promoting problem-solving skills in metalwork students. The study also found that the physical examples of metalwork projects or design challenges were more effective for promoting problem-solving skills when they were accompanied by additional strategies, such as providing instruction on how to approach the problem, providing feedback and guidance and introducing students to a variety of problem-solving techniques.

3.4 Development of Resilient and Solution-oriented Mindsets

This quantitative survey results further revealed that lecturers strongly believed that the development of resilient and solution-oriented mindsets significantly contributed to students' problem-solving abilities. This result is in tandem with the finding of Coskun et al. (2014), which indicated that the cultivation of resilient and solution-oriented mindsets has a positive impact on problem-solving skills in metalwork students, as perceived by their lecturers. They observed that students who possessed these mindsets exhibited greater perseverance, adaptability and creativity in tackling metalwork-related challenges. Moreover, lecturers perceived that students with problem-solving mindsets were more willing to seek alternative solutions and learn from their mistakes, leading to improved problem-solving outcomes. This emphasizes the significance of integrating mindset development strategies into metalwork education programs. By encouraging students to adopt a problem-solving mindset, educators can enhance students' abilities to navigate complex metalwork challenges effectively (Boyles, 2022). These findings have implications for curriculum design, teaching methodologies and instructional support, facilitating the development of well-rounded metalwork students capable of addressing real-world problems in their future careers.

4.0 Conclusion

The research findings highlight the importance of implementing strategies such as encouraging flexibility and openness, integrating critical thinking activities, utilizing informational resources, sharing physical examples and fostering resilient and solution-oriented mindsets to promote problem-solving skills in metalwork students. These strategies can contribute to the comprehensive development of students' problem-solving abilities and prepare them for success in the field of metal fabrication. Furthermore, the research findings suggest that the identified strategies are universally applicable and effective across diverse groups of students. It reinforces the notion that problem-solving skills can be nurtured and developed through targeted educational approaches, regardless of individual characteristics or demographics.

4.1 Recommendations

The following recommendations were made based on the above findings:

1. The school authority and lecturers or instructors of metalwork should nurture students' flexibility and openness to new approaches in metal fabrication and incorporate design challenges that encourage students to think outside the box and explore alternative solutions. This can be made possible by provide opportunities for students to collaborate and share different approaches to metal fabrication projects. Also, they should invite guest speakers or industry professionals to share their experiences and innovative techniques with students.
2. The school authority and lecturers or instructors of metalwork should design problem-solving exercises that require students to analyze, evaluate and make informed decisions by incorporating case studies or real-world scenarios into the curriculum to enhance critical thinking skills. They should provide guidance and feedback during critical thinking activities to help students develop their analytical abilities.
3. The school authority and lecturers or instructors of metalwork should curate a collection of relevant books, articles, and videos for students to access as resources for their metalwork projects. Teach students how to effectively research and evaluate information from various sources; and encourage students to critically analyze and compare different approaches and techniques demonstrated in videos or discussed in literature.
4. The school authority and lecturers or instructors of metalwork should create a gallery or display area where students can showcase their completed metalwork projects.

These stakeholders should organize regular exhibitions or open-house events to allow students to present their work to their peers, teachers and industry professionals. They can encourage students to document their projects with photographs or videos and create a digital portfolio to showcase their skills.

5. Metalwork stakeholders should create a supportive and positive learning environment that encourages students to embrace challenges and learn from failures. Lecturers should teach students strategies for managing setbacks and overcoming obstacles in the metal fabrication process. They should as well provide opportunities for reflection and self-assessment to help students develop a growth mindset and resilience.

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